

LISTING OF THE CLAIMS

This listing of claims, including the amendments indicated below, is intended to replace all prior versions, and listings, of claims in the application

1. (Canceled)

2. (Currently Amended) An optical imaging device comprising:

a light source for supplying low coherence light to irradiate an object so that tomographic images of the object can be constructed based on returning light reflected or scattered from the object;

a light irradiating/receiving unit for irradiating the object with said low coherence light and for receiving said returning light, said light irradiating/receiving unit including a first optical scanning block capable of scanning said object at least one-dimensionally in a direction of light reception or irradiation;

a first light path member over which a portion of the low coherence light is propagated to said object and said returning light is propagated to said light irradiating/receiving unit;

a second light path member over which a further portion of the low coherence light is propagated to provide a reference light beam;

a first optical branching unit, interposed between said light source and said first optical scanning block, for branching the low coherence light supplied from said light source into said first optical scanning block and said second light path member;

a second optical branching unit, included in said first optical scanning block, for branching out the returning light from said first optical scanning block;

a third light path member over which the returning light branched out by said second optical branching unit is propagated;

a coupling unit for coupling the reference light beam propagated over said second light path member and the returning light propagated over said third light path member to create interference between the reference beam and the returning light;

a detection unit for detecting the interference caused by said coupling unit to produce an interfering signal;

an optical length variation unit, coupled to one of said second and third light path members, for varying at least one of a phase delay and a group delay of light between an incident light path and an emitted light path, said optical length variation unit including:

a movable light-transmissive optical element interposed between the incident light path and emitted light path, and

a drive mechanism operative to impart cyclic motion to the light-transmissive optical element so that a point at which light in the second and third light paths interfere is scanned in the optical-axis direction as the light-transmissive optical element moves; and

an image production unit for processing the interfering signal detected by said detection unit to produce a tomographic image of said object.

~~An optical imaging device according to Claim 1,~~ wherein said drive mechanism is operative to rotate said light-transmissive optical element on an axis of rotation, and said rotation causes light propagated along said incident light path to be deflected cyclically relative to said axis of rotation.

3. (Currently Amended) An optical imaging device comprising:

a light source for supplying low coherence light to irradiate an object so that tomographic images of the object can be constructed based on returning light reflected or scattered from the object;

a light irradiating/receiving unit for irradiating the object with said low coherence light and for receiving said returning light, said light irradiating/receiving unit including a first optical scanning block capable of scanning said object at least one-dimensionally in a direction of light reception or irradiation;

a first light path member over which a portion of the low coherence light is propagated to said object and said returning light is propagated to said light irradiating/receiving unit;

a second light path member over which a further portion of the low coherence light is propagated to provide a reference light beam;

a first optical branching unit, interposed between said light source and said first optical scanning block, for branching the low coherence light supplied from said light source into said first optical scanning block and said second light path member;

a second optical branching unit, included in said first optical scanning block, for branching out the returning light from said first optical scanning block;

a third light path member over which the returning light branched out by said second optical branching unit is propagated;

a coupling unit for coupling the reference light beam propagated over said second light path member and the returning light propagated over said third light path member to create interference between the reference beam and the returning light;

a detection unit for detecting the interference caused by said coupling unit to produce an interfering signal;

an optical length variation unit, coupled to one of said second and third light path members, for varying at least one of a phase delay and a group delay of light between an incident light path and an emitted light path, said optical length variation unit including:

a movable light-transmissive optical element interposed between the incident light path and emitted light path, and

a drive mechanism operative to impart cyclic motion to the light-transmissive optical element so that a point at which light in the second and third light paths interfere is scanned in the optical-axis direction as the light-transmissive optical element moves; and

an image production unit for processing the interfering signal detected by said detection unit to produce a tomographic image of said object,

~~An optical imaging device according to Claim 1,~~ wherein said optical length variation unit further comprises:

a spectrum dispersion element for spatially dispersing the spectrum of light entering along the incident light path;

a light introduction block for introducing light from said incident light path to said spectrum dispersion element;

a spectrum reuniting element optically coupled to light exiting said light-transmissive optical element for reuniting the angular frequency components of the spatially dispersed light which are phase-modulated by said light-transmissive optical element; and

a light pickup block for routing light emitted from said spectrum reuniting element to said emitted light path, and

wherein the light-transmissive optical element being optically coupled to light exiting said spectrum dispersion element for substantially linearly modulating the phases of angular frequency components of the light dispersed by said spectrum dispersion element, and a gradient in the phases of the angular frequency components of light modulated by the movement of said light-transmissive optical element is changed with the passage of time.

4. (Previously Presented) An optical imaging device according to Claim 3, wherein:

said light introduction block comprises an introduction single-mode optical fiber over which light is introduced externally to said optical path length variation unit, and a first positive lens;

said spectrum dispersion element comprises a pair of a first diffraction grating and a second positive lens;

said light-transmissive optical element is realized with a wedged prism made of a light-transmissive material and mounted for rotation on an axis, substantially parallel to a direction of light propagation;

said spectrum reuniting element comprises a pair of a second diffraction grating and a third positive lens; and

said light pickup block comprises a fourth positive lens and a pickup single-mode optical fiber over which light is extracted from said optical length variation unit.

5. (Previously Presented) An optical imaging device according to Claim 4, wherein focal lengths for said third positive lens and fourth positive lens meet a condition expressed as follows:

$$NA > f_2 (n-1) \phi / f_4 \quad (\text{condition 1})$$

where f_2 denotes the focal length for said third positive lens, f_4 denotes the focal length for said fourth positive lens, n denotes the refractive index of said wedged prism, ϕ denotes an acute angle of said wedged prism, and NA denotes a numerical aperture of said pickup single-mode optical fiber.

6. (Canceled)

7. (Previously Presented) An optical imaging device according to Claim 4, wherein a point through which a principal ray of light incident on said optical length variation unit, of which angular frequency corresponds to the center angular frequency component of the light, passes is matched with the center of rotation of said wedged prism; and said wedged prism is located on at least one of a reference light path and a sample light path.

8. - 82. (Canceled)

83. (Currently Amended) An optical imaging device comprising:
a low coherence light source;
first and second optical paths;
a first optical coupler for delivering light from the light source to the first optical path to serve as an inspection light beam and to the second optical path to serve as a reference light beam;
a light irradiating/receiving unit coupled to the first light path for supplying light to irradiate an object and for receiving returning light reflected or scattered from said object,
a second optical coupler for delivering the returning light to a third optical path;
a third optical coupler between the second and third optical paths to create optical interference between the reference beam and the returning light;
a detection unit responsive to the optical interference to produce an interference signal;

an optical length variation unit, coupled to one of said second and third light paths for varying at least one of a phase delay and a group delay of light in said one light path, the optical length variation unit including:

a movable light-transmissive optical element interposed between said one of said second and third light paths and an emitted light path, and

a drive mechanism operative to impart cyclic motion to the light-transmissive optical element so that a point at which light in the second and third light paths interfere is scanned in the optical-axis direction as the light-transmissive optical element moves; and

an image production unit for processing the interference signal to produce a tomographic image of said object,

~~An optical imaging device according to Claim 82,~~ wherein said drive mechanism is operative to rotate said light-transmissive optical element on an axis of rotation, and said rotation causes light propagated along said incident light path to be deflected cyclically relative to said axis of rotation.

84. (Currently Amended) An optical imaging device comprising:

a low coherence light source;

first and second optical paths;

a first optical coupler for delivering light from the light source to the first optical path to serve as an inspection light beam and to the second optical path to serve as a reference light beam;

a light irradiating/receiving unit coupled to the first light path for supplying light to irradiate an object and for receiving returning light reflected or scattered from said object,

a second optical coupler for delivering the returning light to a third optical path;

a third optical coupler between the second and third optical paths to create optical interference between the reference beam and the returning light;

a detection unit responsive to the optical interference to produce an interference signal;

an optical length variation unit, coupled to one of said second and third light paths for varying at least one of a phase delay and a group delay of light in said one light path, the optical length variation unit including:

a movable light-transmissive optical element interposed between said one of said second and third light paths and an emitted light path, and

a drive mechanism operative to impart cyclic motion to the light-transmissive optical element so that a point at which light in the second and third light paths interfere is scanned in the optical-axis direction as the light-transmissive optical element moves; and

an image production unit for processing the interference signal to produce a tomographic image of said object,

~~An optical imaging device according to Claim 82, wherein said optical length variation unit further comprises:~~

~~a spectrum dispersion element for spatially dispersing the spectrum of light entering along the incident light path;~~

~~a light introduction unit for introducing light from said incident light path to said spectrum dispersion element;~~

~~the light-transmissive optical element being optically coupled to light exiting said spectrum dispersion element for substantially linearly modulating the phases of angular frequency components of the light dispersed by said spectrum dispersion element;~~

~~a spectrum reuniting element optically coupled to light exiting said light-transmissive optical element for reuniting the angular frequency components of the spatially dispersed light which are phase-modulated by said light-transmissive optical element; and~~

~~a light pickup unit for routing light emitted from said spectrum reuniting element to said emitted light path, and~~

~~wherein a gradient in the phases of the angular frequency components of light modulated by the movement of said light-transmissive optical element is changed with the passage of time.~~

85. (Previously Presented) An optical imaging device according to Claim 84, wherein:

said light introduction unit comprises an introduction single-mode optical fiber over which light is introduced externally to said optical path length variation unit, and a first positive lens;

said spectrum dispersion element comprises a pair of a first diffraction grating and a second positive lens;

said light-transmissive optical element is realized with a wedged prism made of a light-transmissive material and mounted for rotation on an axis, substantially parallel to a direction of light propagation,

said spectrum reuniting element comprises a pair of a second diffraction grating and a third positive lens; and

said light pickup unit comprises a fourth positive lens and a pickup single-mode optical fiber over which light is extracted from said optical path length variation unit.

86. (Previously Presented) An optical imaging device according to Claim 85, wherein:

focal lengths for said third positive lens and fourth positive lens meet a condition expressed as follows:

$$NA > f_2 (n-1) \phi / f_4 \quad (\text{condition 1})$$

where f_2 denotes the focal length for said third positive lens, f_4 denotes the focal length for said fourth positive lens, n denotes the refractive index of said wedged prism, ϕ denotes an acute angle of said wedged prism, and NA denotes a numerical aperture of said pickup single-mode optical fiber.

87. (Previously Presented) An optical imaging device according to Claim 85, wherein a point through which a principal ray of light incident on said optical path length variation unit, of which angular frequency corresponds to the center angular frequency component of the light, passes is matched with the center of rotation of said wedged prism; and said optical phase modulator is located on at least one of a reference light path and a sample light path.